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Attorney Docket Number RA-5368

Remarks

In the Office Action dated 4/7/2005 ("Office Action"), Claims 1-26 were
rejected.   In the amendment set forth above, Claims 5-10, 12-15, 18-23, and 26
are amended. Claim 1-4 and 11 are cancelled, and Claims 16-17 and 24-25 are
as originally presented. In view of these amendments to the Claims, and the
arguments set forth below, it is respectfully submitted that Claims 4-10 and 12-26
are in condition for allowance.

Arguments

1.   Claims 1-26 were rejected under 35 USC §112 second paragraph as
being indefinite for failing to particularly point out and distinctly claim the subject
matter of the invention. In particular:

   A.   Claims 1-4 were said to include a limitation that lacked an
antecedent basis. Claims 1-4 have been cancelled in the above amendment.

        Claim 12 was said to lack an antecedent basis for the limitation
"said any tasks pending". The term "said any task" in line 2 of Claim 12, and all
subsequent references to "said any tasks pending" have been changed to
reference "one or more tasks".

        Further in regards to Claim 12, "said next assigned task" is said to
lack antecedent basis. This term has been deleted.

        With the foregoing changes, this rejection of Claims 1-4 and 12 are
believed to be overcome.

   B.   Additional language in Claims 1-26 is said to be indefinite. In
particular, Claims 1-26 are said to include misuse of punctuation. Punctuation
changes have been made in various ones of the Claims, and it is believed this
rejection has been overcome.

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In regards to Claim 5, the following rejections are raised:

The limitations spanning lines 2-4 of Claim 5 are said to be unclear. These limitations have been deleted.

The limitation of lines 4-6 concerning the "a next available IP resource available to a scheduler queue on which pointer to said at least two tasks reside" is said to be unclear. This limitation has been amended to "next available IP resource".

In regards to line 11, it is said the phrase "transferring control from said second stage lottery program to a task found" is unclear. This phrase has been modified to clarify that control of the next available IP resource is being transferred from executing said second stage lottery program to a task associated with the selected task level.

Finally, in regards to Claim 8 lines 1-2, it is said that it is unclear whether tasks have quantum values. A clarifying phrase has been added to this Claim to describe that a respective quantum value defines a variable time period for assigning a task to an IP.

With the above-described amendments to the Claims, it is believed Claims 1-26 now satisfy the requirements of 35 USC §112 second paragraph, and this rejection should be withdrawn.

2.   Claims 1-26 were rejected under 35 USC §103(a) as being unpatentable over the paper entitled "Time-Function Scheduling: A General Approach to Controllable Resource Management" by Liana L. Fong et al. ("Fong"). This rejection is respectfully traversed.

Before addressing the specifics of the rejection in detail, a summary of Fong and the current rejection is provided for discussion purposes.

Fong primarily describes a general approach to resource management called Time-Function Scheduling (TFS). According to this method, all runnable jobs with similar characteristics are assigned to a particular job class. A time-function is associated with each job class. (Page 7, Section 2.1, first paragraph.)

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Jobs are scheduled on a First-Come, First-Server (FCFS) manner within each class. (Page 6, last full sentence.)

In addition to describing the TFS method of resource allocation, Fong compares the performance of this method with a prototype system that implements a lottery method of resource allocation. Fong describes a lottery approach generally as follows:

> 'Under lottery scheduling, resource rights are represented by lottery tickets and the resource is granted to the job with the \winning" (sic) ticket.' (Fong page 13 section 3.2, first sentence.)

The Fong lottery prototype system implements a modified version of this lottery method as follows:

> "Our prototype therefore implements a slightly modied (sic) version of lottery scheduling in which tickets are assigned to job classes instead of individual jobs. The resource is then granted to the job at the head of the run-queue associated with the class holding the winning ticket. An FCFS ordering is maintained at each run-queue." (Fong page 13 section 3.2, lines 6-9.)

Thus, the Fong prototype implements a **one-stage lottery mechanism** that selects a class via a lottery, and then selects the job at the head of the run queue for the selected class. The job is selected on a First-Come, First Serve basis.

Fong compares the prototype that implements the TFS approach with that implementing the lottery method with respect to performance and wait-time variance (that is, the variation between wait times for jobs in a same class.) In this regard, Fong states that compared to the lottery method, TFS achieves the same execution rate goals "while significantly reducing the waiting time variance, in some cases by as much as several orders of magnitude." (Fong page 5, second sentence of first full paragraph.) Thus, Fong is stating that TFS is significantly superior to the lottery approach in important respects. While Fong discusses the possibility of utilizing an approach that combines aspects of TFS and lottery scheduling (see Fong page 21, third full paragraph), Fong generally

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teaches away from using the one-stage lottery mechanism implemented in the Fong prototype.

In contrast to the Fong system, Applicants' system and method utilizes a *two-stage lottery mechanism*. According to one aspect of the mechanism, a first lottery (first stage) is conducted to select a class of tasks. A second lottery (second stage) may then be conducted to select one of multiple levels contained in this class. A pending task is then selected from this level. (Applicants' Specification page 8 line 24 through page 9 line 11.) This two-stage lottery can be completed very efficiently, and applies the benefits of the random selection process both to the class selection, and the level selection. Moreover, the use of multiple levels within the class makes the system more flexible, and provides for scheduling options, than any of the systems described in Fong.

Several observations may be made concerning the Fong reference as it relates to Applicants' invention. First, Fong discusses a *one stage lottery*. After a class of jobs is selected via this lottery, the actual job is selected using a First-Come, First-Serve approach, as discussed above. There is no two-stage lottery process. Moreover, the Fong reference is primarily dedicated to discussing the TFS approach. This TFS approach is described as being superior to the lottery approach because it reduces waiting time variance by several orders of magnitude. Thus, Fong actually *teaches away* from using even the one stage lottery approach, and most certainly teaches away from any sort of system that would add yet another lottery stage to the task selection process.

With the foregoing summary available for discussion purposes, the specific Claim language is next discussed.

Independent Claim 5, as currently amended, includes a random number generator and selection program for generating a *first random number* for selecting from among at least two classes. This random number generator and program further generate a *second random number* for selecting from at least two levels within the selected class. A task associated with the selected level is then assigned to the next available IP resource. This *two-stage lottery process,* which includes generating a first random number to select a class, and

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a second random number to select a level, is not taught or suggested by Fong. Fong discusses only a *single lottery stage* for *selecting a class*, with a resource then being "...granted to the job at the head of the run-queue associated with the class holding the winning ticket. An FCFS ordering is maintained at each run-queue." (Fong page 13 lines 30-31.) To re-state, Fong teaches a one stage lottery to select the class, and FCFS ordering to choose a job from the class.

In Fong, the FCFS mechanism for selecting a job is employed because this process is said to result in "...signicant (sic) reductions in variance". (Fong page 13 line 29.) That is, FCFS is said to reduce the variations of wait times for jobs in the same class. Thus, this passage in Fong teaches away from using Applicants' two-stage lottery approach in favor of a one-stage approach that uses FCFS to select a job from a selected class, since this is said to result in less variance than some other methods. In light of this teaching, one skilled in the art would not have any motivation to replace the one-stage lottery and FCFS selection process of Fong with any two-stage process as claimed by Applicants.

Fong teaches away from a second stage lottery approach for another reason. As previously discussed, Fong describes how the TFS scheduling approach results in magnitudes less variance than the one-stage lottery approach described above. Thus, one skilled in the art would not be motivated by Fong to utilize even a one-stage lottery mechanism, much less than any two-stage mechanism. While Fong does describe that a mechanism that combines some aspects of the lottery method into the TFS approach could be beneficially implemented (Fong page 21, first sentence of third full paragraph), Fong teaches away from use of a strict one-stage lottery approach, and most certainly teaches away for any mechanism that would add yet additional lottery stages to a task selection process.

Additionally, it may be noted that Claim 5 describes using the first lottery stage to select a class, and a second lottery stage to select *a level within the class*. A job is then chosen from the selected level. The use of both classes and levels provides a system that is more flexible than a system that uses solely

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classes. Fong does not teach or suggest a system that uses levels within classes to provide this additional flexibility. All of the Fong mechanisms, including the TFS and the one-stage lottery approach, use FCFS to select a job from a class. Nothing in Fong appears to suggest allowing for the creation of various levels within a class such that a level may be selected from which to choose a task.   For this additional reason, Claim 5 is allowable over the current rejection, which is improper, and should be withdrawn.

Finally, as the Examiner notes, Fong does not teach or suggest any transfer program for transferring control of the IP resource from the second stage lottery program to the selected task, as claimed by Claim 5.

To summarize, Fong does not teach or suggest Applicants' Claim 5 for at least the following reasons:

a.)   Fong does not teach or suggest any *two-stage lottery mechanism*, only a one-stage lottery followed by FCFS selection of a job.

b.)   Fong does not teach use of classes *and levels within classes*, providing a system with increased flexibility. Fong only teaches use of classes.

c.)   Fong does not teach or suggest any type of transfer program as is described by Claim 5.

d.)   Fong specifically *teaches away from a two-stage lottery mechanism* that conducts a lottery as a second stage of a selection process, since Fong repeatedly discusses that using an FCFS mechanism during the second phase of the selection process provides the benefit of significantly decreasing variance.

e.)   Fong specifically *teaches away from using even a one-stage lottery mechanism*, since Fong repeatedly describes that using the TFS method provides the same performance as, but magnitudes less variance than, the one-stage lottery mechanism that is used as the comparison prototype.

For all of the foregoing reasons, the Examiner has failed to set forth a prima facie case for obviousness in regards to Claim 5. This rejection is therefore improper, and should be withdrawn.

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Claims 6 - 10 depend either directly or indirectly from Claim 5 and are allowable for all of the reasons discussed above in regards to Claim 5. These Claims are further allowable because they describe additional aspects not taught or suggested by Fong as follows.

Claim 6 describes a level switching routine that re-selects levels if the originally-selected level is not associated with a task. As previously discussed, Fong does not teach the aspect of having multiple levels within a class, nor the concept of selecting a level from which to obtain a task. Therefore, Fong certainly does not teach or suggest the notion of re-selecting levels if it is determined that an originally-selected level is not associated with a task.

In regards to Claim 6, the Examiner states the claimed aspects are taught on page 14 lines 1-19. That cited code listing is described in Fong as implementing the modified version of the lottery scheduler in which a job class is selected, then the job at the head of the FCFS run-queue for the class is granted the resource (Fong page 13, lines 7-9 of Section 3.2) This code or the associated Fong description does not appear to have anything to do with level selection, or re-selecting a level within a class if a task is not associated with the originally-selected level. If this rejection is maintained, clarification is respectfully requested regarding the significance of the cited passage in regards to the limitations of Claim 6.

Turning now to Claim 7, this Claim relates to the aspect of assigning specific probabilities to the different levels of a class. As described above, Fong does not teach or suggest the use of levels within a class, and does not describe the specific probabilities described within Claim 7. For this additional reason, Claim 7 is allowable over the current rejection.

Claim 8 describes the aspect wherein all tasks associated with a same level have a same quantum value, wherein this value identifies an amount of time a task from this level will be assigned to the next available resource. As previously discussed, the use of levels is not taught by Fong, and Fong does not teach the additional aspect of associating the same quantum value with all tasks within a level. For this additional reason, Claim 8 is allowable over the current

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rejection.

    In reference to the foregoing, it may be noted that the Examiner cites page 16 line 22 as teaching the aspect of Applicants' Claim 8. The cited passage of Fong is discussing that the times for each class are all the same, namely one time quantum. . Thus, this cited passage wherein all time quantums within a *class are the same* is actually teaching away from Applicants' invention wherein a single class may have multiple levels, with each level being associated with a . different quantum value. That is, Applicants' Claim 8 describes that the tasks of a same level have the same quantum value, allowing for *multiple quantum values within a single class,* which is very different from the Fong teaching of one value per class, as discussed in the cited passage.

    Claims 9 and 10 relate to aspects of adjusting a quantum value for a task. These Claims include additional aspects not taught or suggested by Fong. For instance, Claim 10 describes the aspect of not adjusting allocated time if an interrupt occurred. Nothing in Fong appears to teach, or in any way suggest, this aspect of Applicants' invention.

    To summarize, Claims 5 – 10 are allowable for all of the reasons discussed in regards to Claim 5. Claims 6-10 include additional aspects not taught or suggested by Fong, and are allowable over this rejection for the additional reasons discussed above.

    Next, Independent Claim 12 is considered. This Claim includes aspects that are similar to those discussed above in regards to Claim 5. In particular, this Claim describes a two stage lottery execution process that uses a first lottery process for determining a class, and a second process to select an assigned task. As previously discussed, Fong does not teach or suggest a two-stage lottery process, and, in fact, teaches away from such a process in several different ways. Therefore, for reasons similar to those discussed above in regards to Claim 5, Claim 12 is allowable over this rejection.

    Claims 13 – 18 depend from Claim 12 and are allowable over this

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rejection for reasons similar to those discussed in reference to Claims 5 and 12. These Claims include additional aspects not taught or suggested by Fong. For instance, Claim 15 describes a class that is "above the lottery line". Tasks in this class are executed prior to running scheduler code. This describes Applicants' use of one or more classes that are not subjected to the lottery process. Nothing in Fong teaches or suggests this aspect of Applicants' invention.

Claim 17 describes an aspect wherein if none of the classes has any tasks, the scheduler code selects a low priority operating system task. This is not taught or suggested by Fong.

Claim 18 describes the selection between multiple levels of a class during the second stage of the lottery. As previously discussed in reference to Claim 5, nothing in Fong teaches or suggests the use of multiple levels within a class.

In sum, Claims 12-18 are allowable over this rejection for reasons similar to those discussed in reference to Claim 5. Claims 13-18 include additional aspects not taught or suggested by Fong, and are allowable over this rejection for the additional reasons discussed above.

Independent Claim 19 describes a method that include running a first stage of a lottery algorithm to select a class, and running a second stage to select a priority level from this class from which to select a task. Independent Claim 20 includes aspects similar to those described in Claim 19. For reasons similar to those discussed above in regards to Claim 5, Claims 19 and 20 are allowable over this rejection, which is improper, and should be withdrawn.

Claims 21-25 depend from Claim 20 and are allowable over this rejection for reasons similar to those discussed above in regards to the independent Claims. These Claims include additional aspects of the invention not taught by the cited reference. For instance, Claim 22 includes specific aspects about adjusting the quantum value and priority level based on whether more than a predetermined small portion of the quantum was utilized during a last resource allocation. The specific manner in which this adjustment is made as described in

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Claim 22 is not in any way taught or suggested by Fong.

      Claim 23 relates to assigning the quantum before a task pointer is placed on a scheduler queue. This aspect is said to be taught by page 7 line 20 – page 8 line 4 of Fong. This passage describes the Fong time-function of a job being reset when it is placed on a queue. This passage does not relate to any type of task pointer, and does not appear to teach or suggest assigning any type of quantum values prior to a task pointer being added to a queue. For these additional reasons, this Claim is allowable over the current rejection.

      Claim 25 relates to the "lottery line" and is allowable over this rejection for at least the reasons discussed above in regards to Claim 15.

      Independent Claim 26 describes a two-stage lottery process, and is allowable over this rejection for reasons similar to those discussed in regards to Claim 5 above.

      To summarize, Fong does not in any way teach or suggest Applicants' two-stage lottery mechanism described in each of the independent Claims. In fact, Fong actually teaches away from even a one-stage lottery approach, and most definitely teaches away from any approach that would add multiple lottery stages to the selection process, as lottery stages are said to increase wait time variances by an unacceptable amount. Other aspects of the invention described in the dependent Claims are likewise not taught or suggested by Fong. For at least the foregoing reasons, the current rejection is improper, and a Notice of Allowance is respectfully requested.
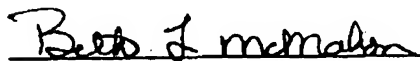
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Conclusion

In the Office Action dated 4/7/2005, Claims 1-26 were rejected.   In the amendment set forth above, Claims 5-10, 12-15, 18-23, and 26 are amended. Claim 1-4 and 11 are cancelled, and Claims 16-17 and 24-25 remain as originally presented. In view of these amendments to the Claims, and the arguments set forth above, it is respectfully submitted that Claims 4-10 and 12-26 are in condition for allowance, and an early Notice of Allowance is respectfully requested. If the Examiner has any questions or concerns regarding this response, a call to the undersigned in appreciated and welcomed.

Respectfully submitted,

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